

CLAIMS

I CLAIM:

1. A low loss flow limited passageway, comprising:
a duct having a wall that defines a flow passageway, and including at least an inlet port in fluid communication with the flow passageway, the inlet port adapted to receive a flow of fluid from an inlet plenum and having at least a first cross sectional flow area, at least a portion of the flow passageway downstream of the inlet port having a second cross sectional flow area that is less than the first cross sectional flow area; and
one or more flow limiting passages extending through the duct, the one or more flow limiting passages including an (i) inlet port in fluid communication with the inlet plenum and (ii) an outlet port in fluid communication with the duct flow passageway proximate the portion thereof having the second cross sectional flow area.
2. The passageway of Claim 1, wherein:
the duct further includes an inner surface that defines the flow passageway; and
the flow limiting passage outlet port further includes a central axis that extends perpendicularly therefrom into the duct flow passageway, the central axis forming an injection angle with respect to the duct inner surface.
3. The passageway of Claim 1, wherein the one or more flow limiting passages are substantially straight between the inlet and outlet ports.
4. The passageway of Claim 1, wherein at least selected ones of the one or more flow limiting passages include one or more bends between the inlet and outlet ports.

5. The passageway of Claim 4, wherein the inlet ports of the selected ones of the one or more flow limiting passages are disposed at a location of predetermined static pressure adjacent the duct inlet port.

6. The passageway of Claim 1, wherein the inlet port is configured as a low loss inlet.

7. The passageway of Claim 6, wherein the low loss inlet is configured as a well-rounded low loss inlet.

8. A low loss flow limited passageway, comprising:

a duct having a wall that defines a flow passageway, and including at least an inlet port in fluid communication with the flow passageway, the duct inlet port adapted to receive a flow of fluid from an inlet plenum and having cross sectional flow area that varies, whereby when fluid flows through the inlet port into the flow passageway a minimum static fluid pressure is developed in the flow passageway at a location adjacent the inlet port; and

one or more flow limiting passages extending through the duct, the flow limiting passages including an inlet port in fluid communication with the inlet plenum and an outlet port in fluid communication with the duct flow passageway proximate the location where the minimum static fluid pressure is developed.

9. The passageway of Claim 8, wherein:

the duct further includes an inner surface that defines the flow passageway; and

the flow limiting passage outlet port further includes a central axis that extends perpendicularly therefrom into the duct flow passageway, the central axis forming an injection angle with respect to the duct inner surface.

10. The passageway of Claim 8, wherein the one or more flow limiting passages are substantially straight between the inlet and outlet ports.

11. The passageway of Claim 8, wherein at least selected ones of the one or more flow limiting passages include one or more bends between the inlet and outlet ports.

12. The passageway of Claim 11, wherein the inlet ports of the selected ones of the one or more flow limiting passages are disposed at a location of predetermined static pressure adjacent the duct inlet port.

13. The passageway of Claim 8, wherein the inlet port is configured as a low loss inlet.

14. The passageway of Claim 13, wherein the low loss inlet is configured as a well-rounded low loss inlet.

15. The passageway of Claim 8, wherein:
the duct inlet port cross sectional flow varies from a maximum area to a minimum area; and
the duct flow passageway downstream of, and adjacent to, the duct inlet port has a cross sectional flow area that varies from the minimum area to the maximum area,
whereby the duct inlet port and duct flow passageway adjacent to the duct inlet port form a flow venture.

16. A low loss flow limited passageway, comprising:

a duct having a wall that defines a flow passageway, and including at least an inlet section, the duct inlet section including (i) an inlet flow port adapted to receive a flow of fluid from an inlet plenum and (ii) an outlet flow port in fluid communication with the flow passageway, the inlet section configured to have a cross sectional flow area that varies from a maximum cross sectional flow area proximate its inlet flow port to a minimum cross sectional flow area proximate its outlet flow port; and

one or more flow limiting passages extending through the inlet section, each flow limiting passage including (i) an inlet port adapted to receive a flow of fluid from the inlet plenum and (ii) an outlet port disposed proximate the minimum cross sectional flow area and in fluid communication with the flow passageway.

17. The passageway of Claim 16, wherein:

the duct further includes an inner surface that defines the flow passageway; and

the flow limiting passage outlet port further includes a central axis that extends perpendicularly therefrom into the duct flow passageway, the central axis forming an injection angle with respect to the duct inner surface.

18. The passageway of Claim 16, wherein the one or more flow limiting passages are substantially straight between the inlet and outlet ports.

19. The passageway of Claim 16, wherein at least selected ones of the one or more flow limiting passages include one or more bends between the inlet and outlet ports.

20. The passageway of Claim 19, wherein the inlet ports of the selected ones of the one or more flow limiting passages are disposed at a location of predetermined static pressure adjacent the duct inlet port.

21. The passageway of Claim 16, wherein the inlet port is configured as a low loss inlet.

22. The passageway of Claim 21, wherein the low loss inlet is configured as a well-rounded low loss inlet.

23. A low loss flow limiting passageway, comprising:
- a duct having a wall that defines a flow passageway;
 - a flow venturi disposed within the duct flow passageway, the flow venturi having an upstream end, a downstream end, and a flow constricting throat disposed therebetween;
 - one or more flow limiting passages extending through the duct, the one or more flow limiting passages including an (i) inlet port in fluid communication with the flow venturi upstream end and (ii) an outlet port in fluid communication with the flow constricting throat.

24. A low loss flow limited passageway, comprising:

a duct having a wall that defines a flow passageway, and including at least including an inlet structure adapted to receive a flow of fluid from an inlet plenum, the inlet structure configured to have a loss coefficient of about 0.04 or less; and

one or more flow limiting passages extending through the inlet structure, each flow limiting passage including (i) an inlet port adapted to receive a flow of fluid from the inlet plenum and (ii) an outlet port disposed proximate the minimum cross sectional flow area and in fluid communication with the flow passageway.

25. A turbine bleed air system, comprising:

a gas turbine engine including:

an engine case having a bleed air supply plenum disposed therein,

a compressor, a combustor, and a turbine all mounted in flow series within the engine case;

and

a low loss flow limiting duct in fluid communication with the bleed air outlet port, the duct including:

a wall that defines a flow passageway,

an inlet port in fluid communication with the flow passageway, the inlet port adapted to receive a flow of fluid from the bleed air supply plenum and having at least a first cross sectional flow area, at least a portion of the flow passageway downstream of the inlet port having a second cross sectional flow area that is less than the first cross sectional flow area, and

one or more flow limiting passages extending through the duct, the one or more flow limiting passages including an (i) inlet port in fluid communication with the inlet plenum and (ii) an outlet port in fluid communication with the duct flow passageway proximate the portion thereof having the second cross sectional flow area.